ascent and descent and the moisture of the air. If the air is not cloudy and the ascending gradients have been the same as the descending gradients, then, the resulting annual average will be the mean of the two figures given on any line in Table 3, that is to say, it will always be 0.98, and will, therefore, be independent of radiation. In other words, in this ideal case of a cloudless atmosphere and rapid convection, the radiation effect is uniformly distributed throughout the mass, and does not affect the vertical gradient, but, of course, this is far from being the actual condition of the earth's atmosphere.

THE INTERNATIONAL ELECTRICAL CONGRESS AT COMO, ITALY.

An International Electrical Congress was held, September 18–25, 1899, at Como, Italy, in connection with the so-called Volta Electrical Exposition. Modern electrical science began with the work done by Volta, who was a native of Como. The exposition opened with brilliant promise early in the present year, and, notwithstanding the disastrous fire that soon followed, the exposition and the congress form an interesting epoch in the history of electricity. The congress was opened with an address by Colombo, president of the Italian Electro-Technic Association, who also represented the minister of public instruction. Many of the most distinguished electricians were present. Among the items that may especially interest meteorologists, we quote the following from the report by Martinez in The Electrical World and Engineer of October 21, page 615:

Professor Blaserna desired the congress to commit itself in favor of the adoption of the double trolley, or of accumulator traction, for lines passing in the vicinity of scientific laboratories. The proposition was not received with much favor by the audience, which was largely composed of a modern element, to whom the disturbances of a galvanometer in a laboratory had much less importance than the economy of electric traction.

Mr. Gisbert Kapp expressed the opinion of the majority of those present in saying that savants, instead of asking that electric traction systems, which gave such great advantages to the majority of citizens, should be changed, should endeavor to perfect their instruments, so that they would not be disturbed from that cause, and, if this can not be done, they should move their laboratories to the country, far away from electric railways.

M. Campelio expressed his agreement with Mr. Kapp.

Mr. Pinna, director of the Turin electric plant, said that accumulator cars differed little from the trolley in their effects on delicate instruments.

Mr. Mengarini, director of the electrical plant at Rome and engineer of the project of transportation of power from Tivoli to Rome (2,000 horse power at 6,000 volts, a rash proposition in 1891), sought to give some satisfaction to Professor Blaserna, in speaking of the serious trouble produced by electric railway return currents on water and gas pipes. He asked, not that the earth return should be prohibited, but that, in the insulation of street railways, all possible precautions should be taken to avoid damage from the return currents.

The discussion having begun to extend over a wide ground, the president adjourned it to the next meeting, and gave the floor to Professor Blaserna, who read a paper on the variation of the earth's terrestrial magnetism in antiquity. The idea of the investigation was due to a learned and very modest coadjutor of Professor Blaserna, Dr. Folgheraiter, of the University of Rome. Dr. Folgheraiter had observed that earthenware will preserve indefinitely the magnetism that it possessed when it was baked. Etruscan vases, roman bricks, etc., he found presented magnetic phenomena so striking as to enable the terrestrial magnetic conditions existing when they were baked to be deduced. The etruscan vases of the year 600 B. C. showed with certainty that at that epoch the direction of the terrestrial magnetic field was almost vertical at Rome and in central Italy. Professor Blaserna expressed the hope that similar observations would be made in other countries.

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At the joint session with the Italian Physical Society, on September 21, Professor Somigliano of the University of Como, discussed the changes of levels in the Italian lakes, a matter that was also observed by Volta, in connection with Lake Como. This lake, as well as others in Italy, is subject to abrupt changes of level which cannot be explained on the supposition of increased flow of water from the streams flowing therein. Recently instruments have been installed to make observations on Lake Garda, with a view to making a careful study of the phenomena. Professor Chistoni gave some interesting details on electrical discharges on Mount Cimone, 7,100 feet high high, the highest peak of the Apennines in the Tuscany and Lombardy region. An observatory has been placed on the summit of this mountain, where aerial conductors have been installed to study the phenomena of atmospheric electricity, which so much interested Volta.

Professor Voltena read a paper of capital importance on "Energy" in the treatment of which a new method of mathematical analysis was followed.

Professor Lemstrom spoke of the artificial reproduction of the aurora borealis. He advanced the conclusion that there is in the atmosphere a permanent electrical current vertical inflow. Professor Wiedemann did not agree with this opinion, observing that we can not have luminous phenomena with differences of potential as small as those mentioned, which, however, may be caused by alternating currents of high frequency.

In the afternoon of September 22, at the meeting of the Italian Physical Society, Professor Maragoni, of Florence, gave a summary of the different theories of the formation of hail, and concluded that the theory of Volta still remains the most plausible, if slight modifications are applied to it.[1] The discussion was participated in by several of the members.

Señor Zublena proposed that the meeting should express an opinion in favor of the encouragement of theoretical and practical researches relating to hail, the occurrence of which in certain parts of Italy constituted a real affliction.

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Professor Bongiovanni showed an apparatus illustrating the phenomena of terrestrial magnetism, and M. Arno made some interesting experiments on the rotations of insulating disks by electro-static action.

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At the last meeting of the Physical Society, Mr. Rizzi, of Naples, read a paper on the magnificent colorations in the Gulf of Naples. He showed that the explanations which have thus far been given concerning the marvelous coloring of the sea and of the sky in that locality do not suffice.

The meeting expressed the wish that the Italian Government should undertake the publication of the complete edition of all the works of Volta, as it has already done for the works of Galileo.

INSTRUCTIVE LABORATORY EXPERIMENTS.

On another page we publish a short contribution by Mr. Ralph B. Marean on whirling columns of mist. This suggests one of many forms of experimentation practicable in physical laboratories, and essential to the development of exact meteorological science.

It is well known that determinations of the coefficient of viscosity of the air have been made by exact observations upon whirls driven by rapidly-revolving cylinders or circular plates. But in these experiments the inertia of the moving masses is so great that the viscosity becomes a minor matter and is not determined with all the precision that is desirable.

The mist whirls seen by Mr. Marean can, undoubtedly, be formed and observed at pleasure by proper laboratory arrangements. If, as he describes, a whirl of small height but considerable diameter is observed beginning in a lower stratum of mist, but finally is converted into a small, slender, rapidly-rotating column which ascends and is finally converted into a horizontal cloud in which there is no rotation, then it is evident that the ascent is due to the slight buoyancy of the original mass, and probably depends almost wholly upon its having a temperature slightly higher than its surroundings, but the disappearance of the rotation depends on the inter-

[1] It is proper for the readers of the MONTHLY WEATHER REVIEW to remember that according to the theory of Volta, hailstones grow by accretion, as they are alternately repelled upward and downward electrically, between two oppositely charged layers of clouds. This working hypothesis of a century ago is now obsolete in meteorology, and wholly replaced by the convective processes fully explained by Ferrel and the thermo-dynamic processe explained by von Bezold, and abundantly confirmed by observations in balloons and on mountain tops.—ED.

nal friction or viscosity of the moist air, and this connection can be quantitively determined by skillful mathematical and experimental study.

This is but one of a long series of beautiful and fascinating problems in the dynamics of the atmosphere; problems that should attract the students of science in our best universities.

Meteorology has waited long for the collegiate recognition that has lately been accorded it here and there; but its progress is not secured by merely teaching to undergraduates that which is already known; it demands rather that provision be made for the thorough preparation in scientific research of those who desire to devote their lives to the advancement of meteorology. There are half a dozen American universities whose students, instructors, and laboratories could profitably be turned toward the development of those branches of experimental and mathematical physics that bear upon meteorology.

METEOROLOGY IN OUR UNIVERSITIES.

Some years since the Editor sketched out a course of reading, study, and experimentation for the guidance of those students who felt themselves drawn toward this important science, and this course has been announced in the annual catalogues of the Columbian University for a number of years. It has, indeed, never been given by the Editor in full, and may perhaps be too elaborate to be generally practicable. However, it constitutes a comprehensive course of subjects for reading and study that may be useful as a guide to teachers who desire to do the very best that can be done under the limitations imposed by their personal and local conditions.

The courses in meteorology are designed to give a complete review of the present condition of that science, and they extend through six years, but each of the six divisions is complete in itself. Each course presents a detailed view of its branch of the subject, such as may be desired by students who need this information in connection with other branches of knowledge to which they are specially devoting themselves.

In addition to the lectures, the professor devotes one hour a week to a "quiz" class, in which, by questions and answers, he seeks to remove any difficulties that remain.

1. *Observational meteorology.*—Personal diary of the weather; general methods of observing without instruments; the rain gage; the thermometer; the barometer; the nephoscope; the anemometer; hygrometry; actinometry; self-registering apparatus; observations in balloons; observations on mountain stations; meteorological expeditions by land and sea; forms for record; methods of computation of means and normals; graphic methods of presenting results. Two hours per week.

2. *General climatology.*—Elements of climate; general distribution over the earth of sunshine, temperature, moisture, pressure, wind, clouds; diurnal, annual, and secular periodicities; variability of local climates; empirical relations between the winds and the other elements; the absorption of radiations by the atmosphere; the theory of probabilities as used in climatology; the computations of the coefficients of the Bessels-Fourier equation; the climatic features of areas of high and low pressure; the relations between ocean currents and the atmosphere; solar and lunar tides; the constituents of the atmosphere and their variations; atmospheric dust; atmospheric moisture; climatic characteristics of oceanic, continental, and littoral regions; sensible temperatures; constitution of the atmosphere as affected by plants, animals, altitudes, and the ocean; influence of snow, swamps, and forests. Two hours per week.

3. *Special subjects in meteorology and climatology.*—Optical phenomena; thermal phenomena; acoustic phenomena; electrical phenomena; climate and geology; climate and vegetation; climate and anthropology; climate and hygiene; climate and engineering; climate and manufacturing industries; atmospheric dust in relation to rain, geology, vegetation, hygiene, manufactures. Montgomery J. Storm's Cloud Engine. Cloudy Condensation, by Barus, Wilson, and others. The relation of the atmosphere to ordnance operations. Two hours.

4. *Experimental laboratory work in meteorology.*—In this higher field of work the student investigates the theories of several meteorological instruments and pushes his study to some decided advance beyond the present state of knowledge. New apparatus is devised and constructed and the nature of its errors investigated theoretically and experimentally. Old series of observations, conducted with imperfect apparatus and under unfavorable conditions, are reduced and corrected in the light of the newest discussions. The laws of such physical phenomena as have to be considered by meteorologists are investigated by laboratory methods. Among these, for example, are radiation, conduction, and convection of heat; evaporation; the formation of dew, fog, cloud, rain, snow, hail, and lightning; the minute oscillations of wind and pressure; the pressure and movements of the wind, the absorption of radiations from the sun or earth by the atmosphere; the viscosity of the air, convective resistances, etc.; problems in aeronautics, anemometry, kites, resistance of the air to motion; the Schlieren method of Töppler for studying currents and waves of air.

5. *Practical meteorology.*—Methods of projection in cartography; daily weather charts of all nations; international charts of the northern hemisphere; influence of land and ocean on weather and climate; empirical rules as to the variability and constancy of weather and climate in general; the computation of the index of variability of climate by the law of errors; weather types and typical weather charts, both for the United States and for the whole globe; predictions of daily weather by various methods, such as chance, persistency of current conditions, weather types, etc.; special rules for predicting frost, cold waves, rain, snow, and wind; predictions for one, two, and three days; long-range predictions for seasons and climates; precise definition of climate by Hinrich's method, and long-range predictions of Hinrich's climatic exponent; climates in past geological ages; codification of empiric and rational rules for prediction; verification of predictions and the laws of chance involved therein.

6. *Physical and theoretical meteorology.*—Insolation; the absorption, conduction, and radiation of heat by the air, the earth, and the ocean, and the resulting distribution of temperature; the thermo-dynamics of the atmosphere; convective equilibrium; the general circulation of a dry atmosphere on a rotating globe; the influence of oceans and continents, and the motions of the actual atmosphere; local cyclones and anticyclones; atmospheric waves and tides; the distribution of fog, cloud, rain, and snow; optical and electrical phenomena.

WEATHER BUREAU MEN AS UNIVERSITY LECTURERS.

In continuation of our remarks in the MONTHLY WEATHER REVIEW for August, page 365, we note that according to a report from W. M. Fulton, Observer, Knoxville, Tenn., he was authorized by the Chief of the Weather Bureau, in compliance with the request of President Charles W. Dabney to attend farmers and teachers institutes in the State of Tennessee. His absence from station and his expenses were considered a part of his official duty. Mr. Fulton reports as follows:

From August 17 to 21, inclusive, I was engaged in making lantern slides, enlarged charts, and in preparing other equipment for use in my work. I then attended and participated in institutes, as follows: Boons Creek, Tenn., August 22 and 23; Rogersville, Tenn., August 25 and 26; Morristown, Tenn., August 29, 30, and 31; Jackson, Tenn., September 5 and 6; and Larimore, Ala., September 8 and 9, 1899. In regard to the last named point, I would state that Larimore is located in the northeastern portion of Alabama, near the Tennessee State line. I was assured of a large hearing consisting of farmers from north Alabama and east Tennessee, and, not being otherwise engaged, felt it my duty to accept an invitation to lecture at that point. The institute, which was planned for Lenoir City, Tenn., September 12 and 13, was indefinitely postponed in order to avoid conflict with subsequent arrangements made by the State Commissioner of Agriculture.

The institutes enumerated above, except the one at Larimore, were conducted under the supervision of the Agricultural Experiment Station of the University of Tennessee. I was given a prominent place on all programs and took an active part in the work. Stereopticon views (lantern slides), enlarged charts, and milliographed notes were used to illustrate and supplement lectures. The work of the Weather Bureau was explained and discussed. Especial attention was given to the Climate and Crop service; Cotton Region service; cold wave and frost warnings, with some discussion of methods of protection from frost; weather and temperature forecasts, and daily weather charts. The institutes, without exception, were largely attended by intelligent and representative farmers. A decided interest was everywhere manifested in the presentations of the Weather Bureau work. In several instances I was requested to extend a unanimous vote of thanks to the Honorable Secretary of Agriculture and the Chief of the Weather Bureau for having thus brought this work before the institutes. Question boxes contained many pertinent queries concerning all phases of the work. It was my endeavor to first explain the methods which the Bureau is employing to aid the farmer, and, secondly, to furnish information that would enable him to derive the greatest benefit from the service. There was every indication that these two ends were ac-